Enabling Electric Aircraft with Ultra High Energy Lithium Metal Batteries

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Abstract

Green aviation's goals of high energy efficiency, low emissions and reduced noise can be achieved with electric aircraft. A principal barrier to electric aviation is high capacity energy storage. Li-ion batteries (LIB) with metal oxide cathodes, graphite anodes, and organic liquid electrolytes represent the state-of-the-art. However, LIBs have issues in terms of safety and thermal stability. In addition, LIBs fall short of meeting the power and energy requirements for electric aircraft. Breakthroughs beyond the current state-of-the-art in battery technology are necessary to fully realize green aviation.

Recent work has shown certain ionic liquids (IL) electrolytes may suppress the formation of dendrites and show improved cycling capabilities relative to traditional organic electrolytes. The number of possible ionic liquids and other similar electrolytes is vast, and while some ILs show dendrite suppression, others do not. Identifying the fundamental factors controlling the performance of these ultra-high energy Lithium metal batteries (LMB) as well as developing tools for rapid screening and selection of optimal components for fabrication is required to assess fully their potential.

The global objective of this Seedling project is to develop an integrated experimental/computational infrastructure to accelerate fundamental understanding, screening and design of novel IL electrolytes for advanced ultra-high energy LMBs. The novelty of our approach results from the combination of validated computational modeling with experimental screening to produce a reliable predictive capability for the selection of optimal components, their fabrication parameters, and the design of ultra-high energy LMB that can meet energy storage challenges of current and future NASA missions and many terrestrial transportation application such as electric vehicles and aircraft.